



# **PROTOTYPE DESIGN for GLOBAL SEED BANK NETWORK**

ARCH 523 Masters Project Preparation  
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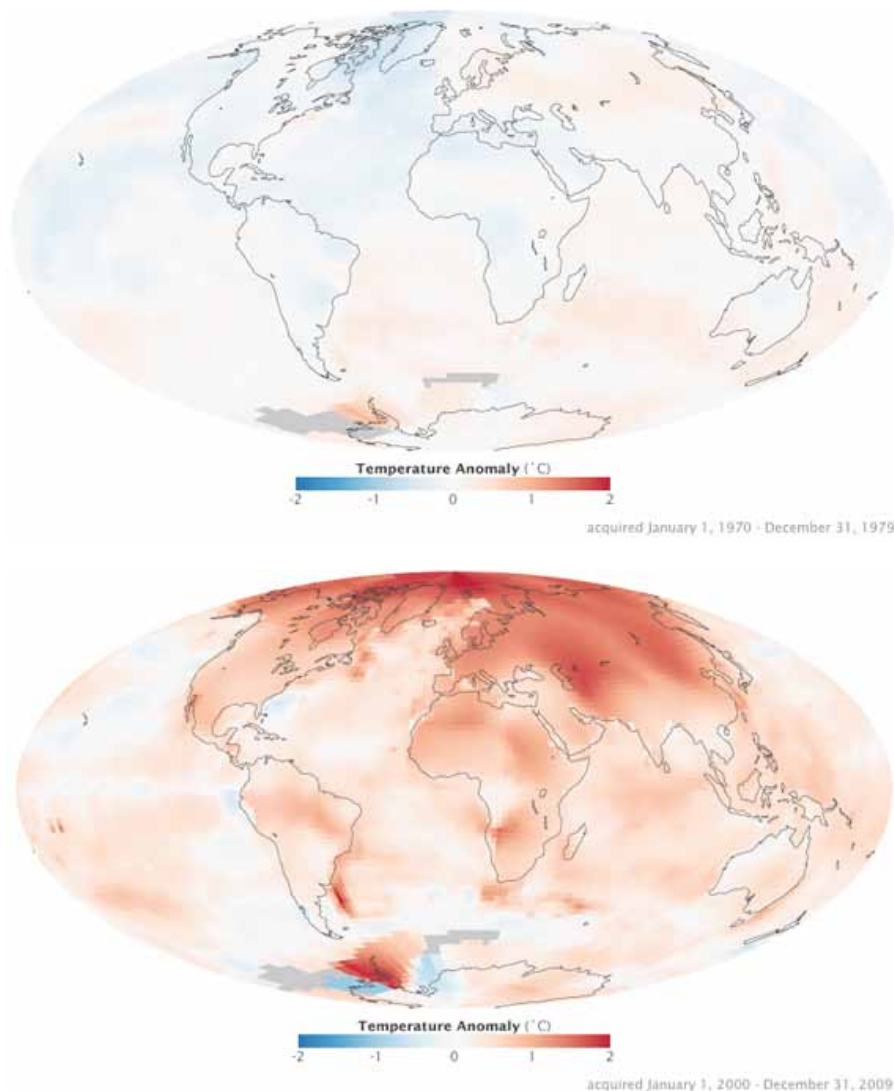
## GLOBAL WARMING - WHAT IS GOING TO HAPPEN?

"A follow-up report by the IPCC released in April 2007 warned that global warming could lead to large-scale food and water shortages and have catastrophic effects on wildlife.

- Sea level could rise between 7 and 23 inches (18 to 59 centimeters) by century's end, the IPCC's February 2007 report projects. Rises of just 4 inches (10 centimeters) could flood many South Seas islands and swamp large parts of Southeast Asia.
- Some hundred million people live within 3 feet (1 meter) of mean sea level, and much of the world's population is concentrated in vulnerable coastal cities. In the U.S., Louisiana and Florida are especially at risk.
- Glaciers around the world could melt, causing sea levels to rise while creating water shortages in regions dependent on runoff for fresh water.
- Strong hurricanes, droughts, heat waves, wildfires, and other natural disasters may become commonplace in many parts of the world. The growth of deserts may also cause food shortages in many places.
- More than a million species face extinction from disappearing habitat, changing ecosystems, and acidifying oceans.
- The ocean's circulation system, known as the ocean conveyor belt, could be permanently altered, causing a mini-ice age in Western Europe and other rapid changes.
- At some point in the future, warming could become uncontrollable by creating a so-called positive feedback effect. Rising temperatures could release additional greenhouse gases by unlocking methane in permafrost and undersea deposits, freeing carbon trapped in sea ice, and causing increased evaporation of water."

Quoted from: National Geographic News. *Global Warming Fast Facts*. Updated 14 June 2007. News.NationalGeographic.com. <[http://news.nationalgeographic.com/news/2004/12/1206\\_041206\\_global\\_warming.html](http://news.nationalgeographic.com/news/2004/12/1206_041206_global_warming.html)>

### National Aeronautics and Space Administration (NASA) Surface Temperature Analysis



## ABOUT THE PROJECT

### **A simple identifier:**

“My project will be a prototype of seed banks.”

### **A short description:**

“My project will be about a network of banks/research centers conserving genetic information of plants, researching possibilities of artificial reproduction and climate adjustment.”

### **A pointed case statement:**

“My project will be developed because due to climate change a lot of plant species are in danger of extinction. As scientists assume, Arctic ice might totally disappear by 2040, which will, of course, cause the changes in water level and therefore, flood a large part of the Earth. They also assume, that by 2070 the lowest temperature will be the highest temperature any plants have ever experienced. So what happens to plants in such case becomes obvious - they die out; this will cause a chain reaction of fauna extinction, since they will have neither shelter nor food.

My project would be a prototype of seed bank for a global network spread throughout the world. I would like to propose locations for multifunctional centers in certain countries, which would be supplied by sub-centers located in others based on long term climate, political and economic predictions. The prototype building will be a modular structure, allowing each country to select functions and size appropriate to them.

The building will include seed storages and labs, where groups of scientists would register and dry collected seeds, then conserve and reproduce them; they will modify plants genetically to help them adjust to new climate conditions.

The facility will also include functions to help rise public interest and awareness and accommodation for travelling scientists.”

## PROJECT GOALS

The idea is important because the results of global warming might be much more destructive in long term than a lot of people might realize; once we lose species of live organisms without a trace, we might never get them back. And it is not just the specific species we lose, but the entire chain reaction tied to it.

Since the issue is global, solving something of that scale is connected to large amount of resources of different kinds. Preserving plants by creating genetic banks for later artificial reproduction seems to me like a more realistic option then preserving entire lands.

The project will solve issues of plant species extinction caused by global warming.

The project will be successful by creating not only one or two centers for species preservation, but by designing an entire system, a net of intellect, specialists from different parts of the world fighting for saving the green.

### Potential Design Responses:

- Creating a net of genetic centers in different endangered parts of the world.
- Designing a prototype building which could work in different climate conditions with the same success.
- Making the system as much off-grid and sustainable as possible.

### CASE STATEMENT

“All human life, all life, depends on plants”, - says the head of commissioning of BBC and main-Board Trustee of Millenium Seed Bank Project Johnathan Drori: “It does not matter if you live in a small African village or a big city - everything comes to plants in the end - whether it’s for the food, the medicine, the fuel, the construction, the clothing, all the obvious things; or whether it’s the spiritual or recreational things that matter to us so much; or whether it’s the soil formation or the effects on the atmosphere, or primary produciton. Damn it, even the books here are made out of plants. All these things, they come back to plants. And without them we would not be here.

Now plants are under threat. They are under threat because of the changing climate. And they are also under threat because they are sharing a planet with people like us. And people like us want to do things that destroy plants and their habitats. And whether it is because of the food production or the introduction of alien plants into places where they really oughtn’t be, or because of habitats being used for other purposes, all these things are meaning that plants have to adapt, or die, or move. And plants sometimes find it rather difficult to move, because there might be cities or other things on the way.

So if all human life depends on plants, doesn’t it makes sense that perhaps we should try to save them?!”

\* Source: Drori, Johnathan. Why we’re storing billions of seeds. TED Talk. Web. Filmed Feb 2009. Posted May 2009. <[http://www.ted.com/talks/jonathan\\_drori\\_why\\_we\\_re\\_storing\\_billions\\_of\\_seeds.html?ga\\_source=embed&ga\\_medium=embed&ga\\_campaign=embed](http://www.ted.com/talks/jonathan_drori_why_we_re_storing_billions_of_seeds.html?ga_source=embed&ga_medium=embed&ga_campaign=embed)>

Climate change in the world has caused extinction of a lot of flora species. According to scientists, by 2070 the lowest temperature on the earth will be the highest plants have ever experienced; therefore, the chances of their survival is really low. Losing plant species will cause various tragic results, including starvation.

Seed banks are institutions created to conserve and preserve plants of the world. Researchers register, study, conserve and genetically modify species of different plants; they want to make sure that the plants are able to survive the climate change and the ones which cannot be modified, are saved until the climate conditions go back to normal.

Because of various political, mechanical or economical reasons seed banks have failed in different countries, which resulted in losing the entire collection. By creating a network of seed banks, I would like to design a system which makes sure there is a backup collection in cases of failure; and later, by designing a prototype seed bank, I would like to propose a standard of the institutions, which can be used in different parts of the network. Modular system will allow the clients to construct the bank of a size appropriate to their needs.

## STAKEHOLDERS

### STAFF

- Researchers and volunteers - to collect, dry and store seeds
- Researchers - to organize and register seeds for archieving
- Researchers - to observe and check seed condition
- Genetic engineers - to modify plants for climate adjustment
- Botanists - to study and take care of the plants in greenhouse
- Mechanical engineers - to observe mechanical systems' performance
- Security - to keep seeds and information safe
- Maintenance - to clean the building

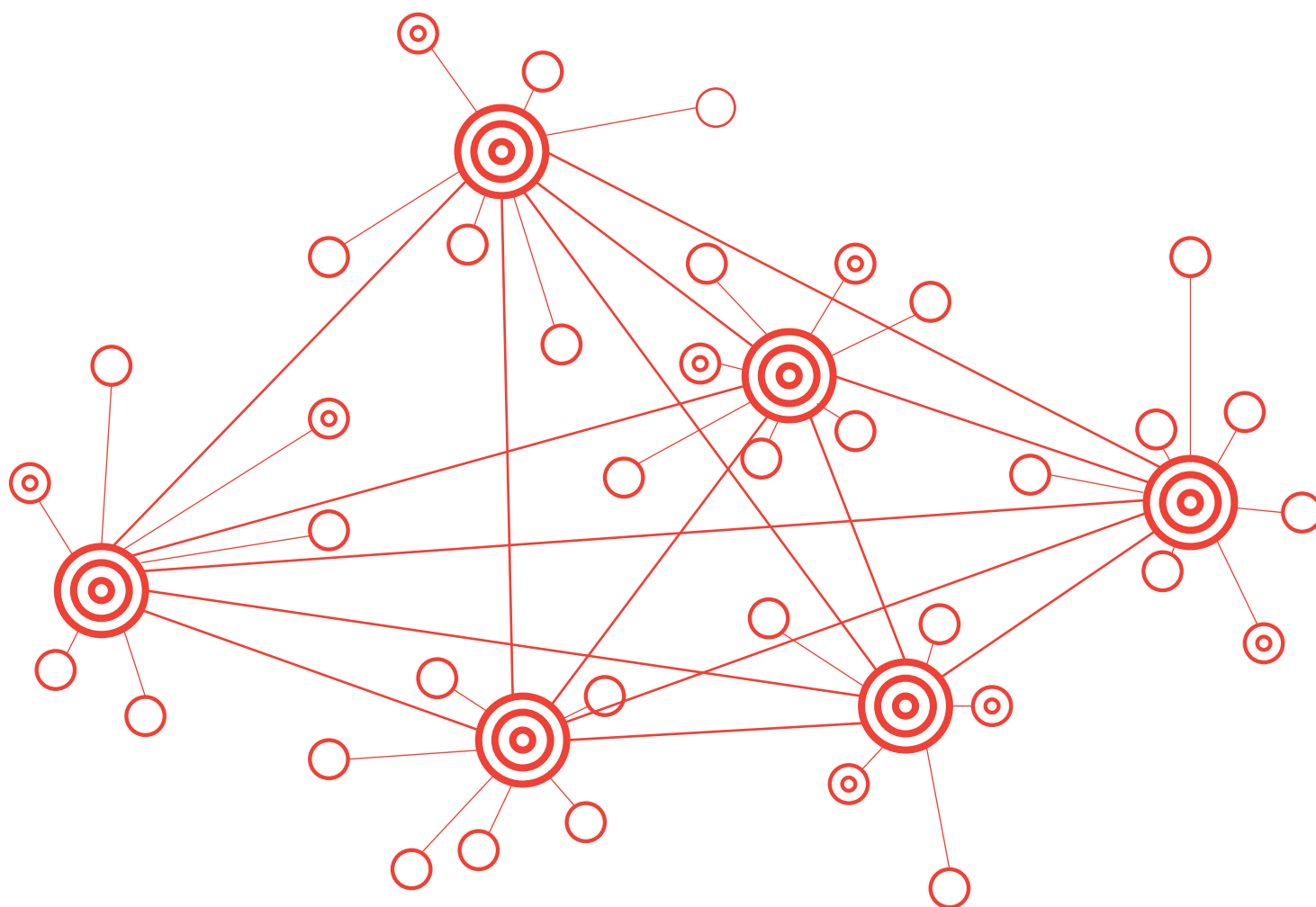
### PUBLIC

- Visiting researchers - to take part in international programs; might need a temporary accommodation if the center is far from the city
- Volunteers - to help researchers in seed collection and maintenance
- Visitors - to visit exhibitions
- Visitors - to attend lectures and conferences

## SEED BANK NETWORK

World floristic genetic information bank network will be spread throughout the world. The program will be distributed in the system of centers and sub-centers. Centers will be international, collecting seeds from different locations and acting as back-up system for sub-centers. They will contain educational and research facilities and will be large in scale, while sub-centers of regional or national meaning will contain only seed storages and green houses.

Diagram Showing Program Distribution Network



- National seed bank. Program: seed storages.
- ⊙ Regional seed bank. Program: green houses, seed storages.
- ⊗ International seed bank. Program: research labs, conservation labs, archieving facilities, exhibition halls and lecture rooms, green houses, temporary accommodation for scientists, archieves, seed storages, green houses.



## CASE STUDIES

## DIAGRAM OF EXISTING SEED BANKS



-  Taxonomic Seed Bank
-  Local Seed Bank
-  National Seed Bank
-  International Seed Bank

\* ENSCONET - Regional seed bank, coordinates seed activities in Europe





\* Location of seed banks might not be accurate.

Sources:

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## MILLENNIUM SEED BANK PROJECT

The largest seed bank of the world Millennium Seed Bank is an international conservation project and research center, a “living library” of over 3 billion seeds, which contains visitor center, as well as residential and educational science facilities.



### Project Data:

Architect: Stanton Williams.

Client: The Royal Botanic Gardens Kew

Location: Wakehurst Place, West Sussex, England.

Status: Completed 2000

Value: £14.0 m

The seed bank was formed to prevent extinction of plant species by storing their seeds and using them in future. Millennium Seed Bank has a global importance; the groups of scientists are responsible for conserving seeds from the entire world - by 2020 the seed bank plans to have species of flora representing 25% of global plant types. They study genetic information of species, take care of their germination tests of every sample in every 10 years, reproduce seeds and send back to their native lands to restore the natural habitat. The building is an interesting hybrid of public and private facilities: offices for scientists are mixed with public exhibition spaces, so that visitors could see how important plant studies are and be inspired by the research process. There are also completely isolated, underground zones with constant temperature and humidity level and the climate control is done very energy efficiently. I believe that studying that building will help me understand the process of plant conservation, spatial and technical needs and public involvement level for my project.

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## Look Inside The Building

### Exhibition Hall



### Labs



### Glass House

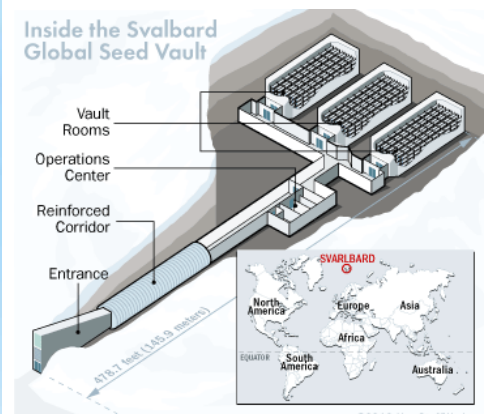


### Storages



## SVALBARD GLOBAL SEED VAULT

Svalbard Global Seed Vault is an underground “backup system” for the world agriculture located about 810 miles from the North Pole. The location allows scientists freeze seeds without mechanical assistance.



### Project Data:

Architect: Peter W.Søderman

Client: The Global Crop Diversity Trust (GCDT)

Location: Longyearbyen, Svalbard, Norway

Status: Completed 2009

Seed banks located around the world are vulnerable due to construction, economical, mechanical or political reasons. Scientists decided to find a safe place on the world, remote from political interests, where they could conserve and preserve different crops' species without mechanical systems, so they chose Svalbard Island – the furthest undisturbed and uninhabited place which is still easy to reach by plane.

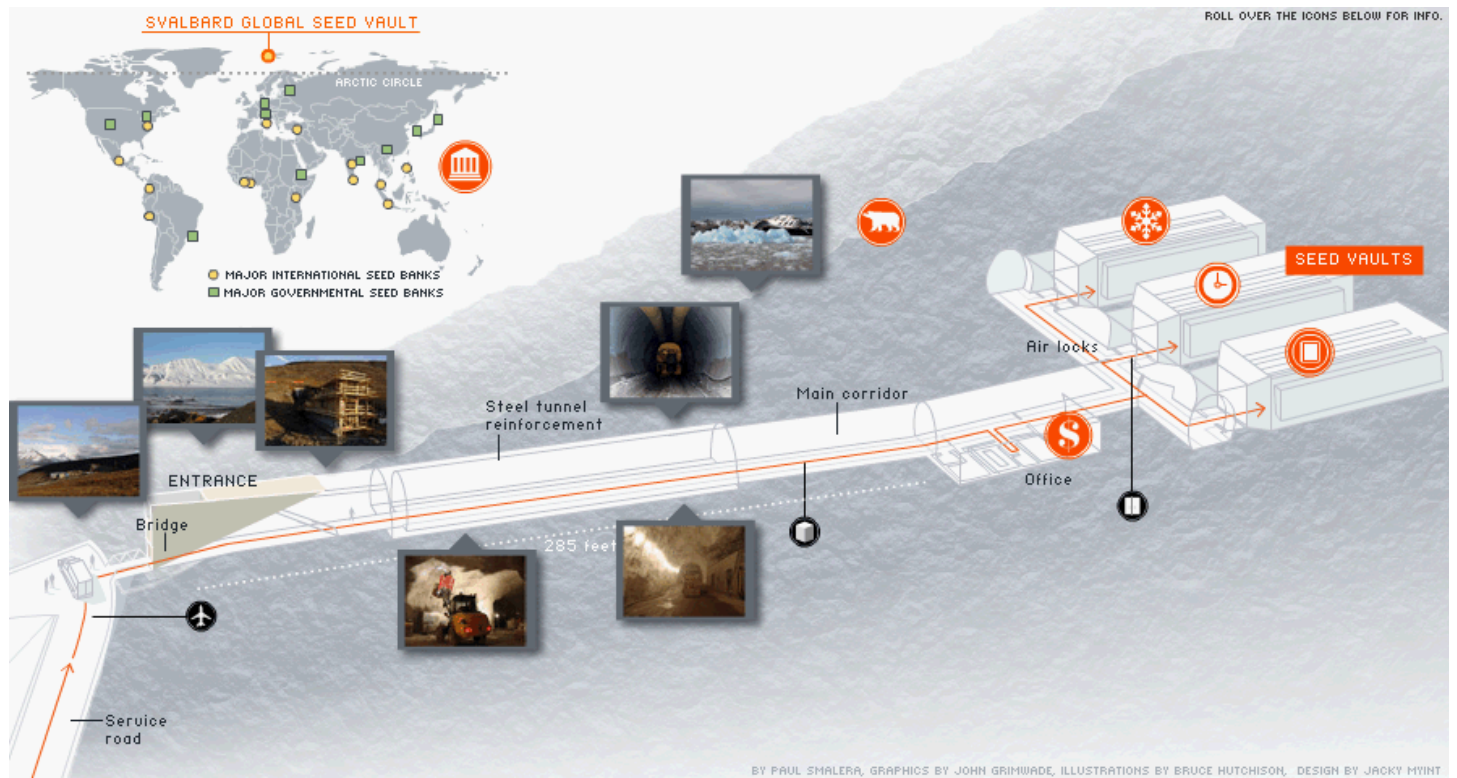
Although this precedent was built purely for ecological reasons and has no public functions, I chose Svalbard Seed Vault because it is interesting for its natural processes and global politics. I also want to explore its storing strategies

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## Look Inside The Building



## Path to Storages



## Storages



## EDEN PROJECT

The largest plant enclosure, the Eden Project is a significant and innovative project for its structural solution, consisting of 8 inter-linked geodesic domes.



### Project Data:

Architect: Nicholas Grimshaw.

Engineer: Anthony Hunt and Associates

Project Manager: Davis Langdon

Constructor: Alfred McAlpine

Biome Design and Construction: MERO

Client: The Eden Project LTD

Location: Cornwall, England.

Status: Completed 2001

Area: 23,000 m<sup>2</sup>

Budget: £57-£75 m

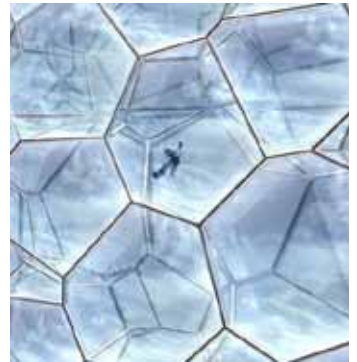
The greenhouse, the shape of which is a beautiful biomimicry of inter-linked soap bubbles, is a home of thousands of species. Innovative use of thermoplastic ETFE allowed the engineers create biomes shaped with very light hexagonal panels, which can span much bigger than glass panels. I would like to research the project's mechanical and structural novelties and advanced technologies for the green house I plan to design for a prototype seed bank.

## REFERENCES

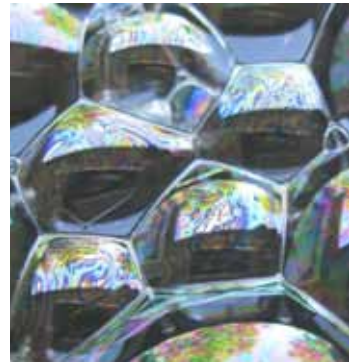
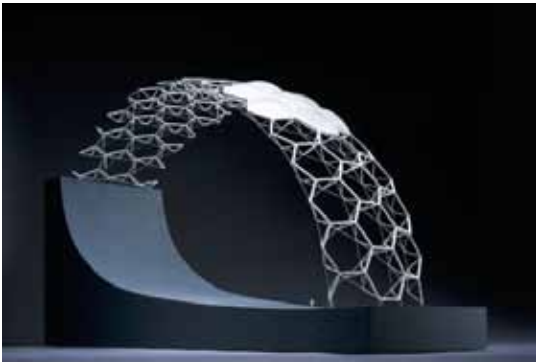
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## Geodesic Domes



## Structure



DESCRIPTION OF STRUCTURE goes here

DESCRIPTION OF MEP goes here

## THE SEED CATHEDRAL

UK pavilion at Shanghai Expo is a beautiful representation of British long traditions of botanical gardens.



### Project Data:

Architect: Heatherwick Studio

Client: Government of UK

Location: Shanghai, China

Status: Completed 2010

Area: 1500 m<sup>2</sup>

Budget: £25 m

Significance of this project is in a different approach to plant presentation – in place of building a greenhouse, Heatherwick studio took seeds to define plants, to highlight how unique and beautiful the beginning of each plant can look like and turned seeds into the jewelry of the pavilion. I would like to research the pavilion as a successful and poetic example of plant exhibition.

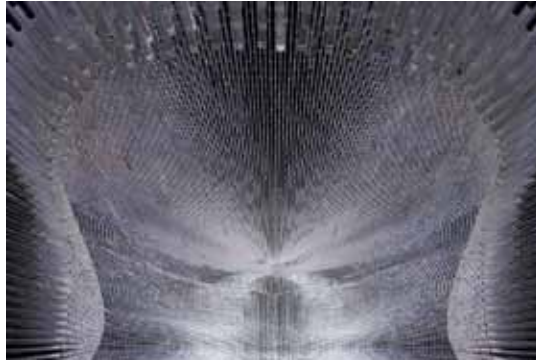
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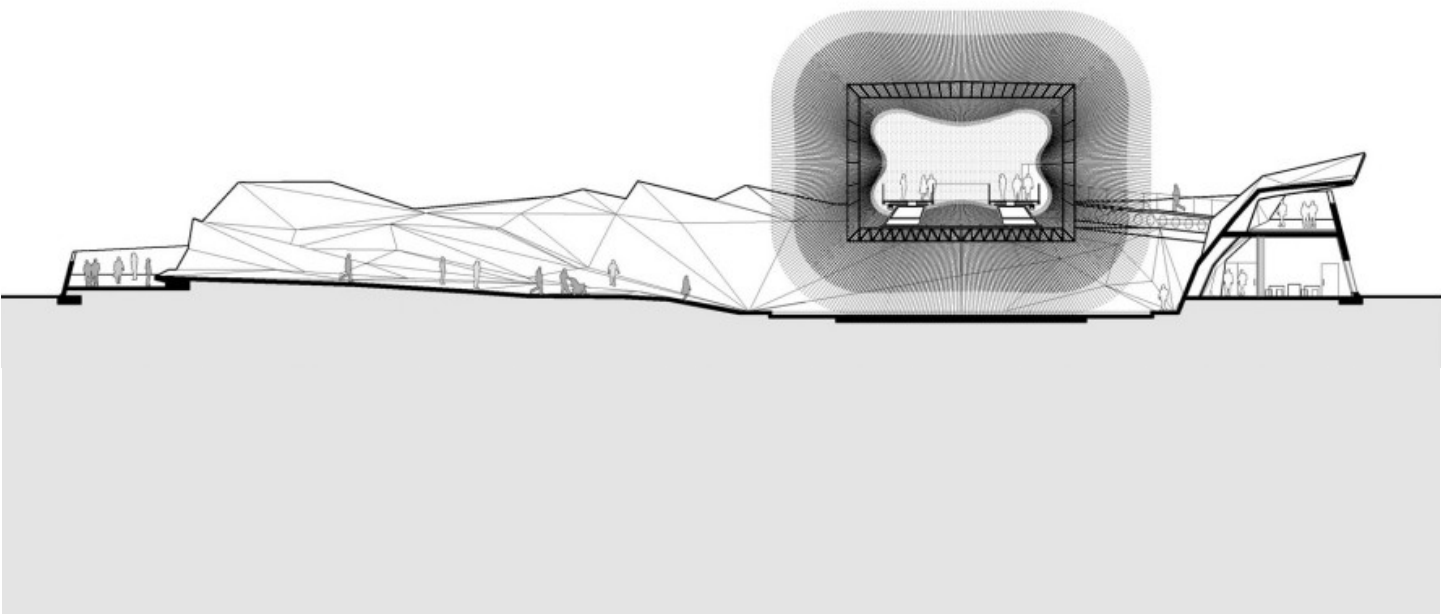
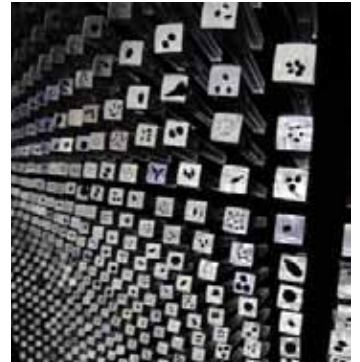


## Look Inside The Building

### Interior



### Fiber optic rods with seeds



## EDF ARCHIVES CENTER

Simple and elegant archive building in France can store 70 kilometers of shelves for paper-based and microfilm-based archived material providing maximum fire protection and constant temperature and humidity.



### Project Data:

Architect: LAN Architecture

Client: EDF

Project Manager: Christophe Leblond

Location: Bure-Saurdon, France

Competition: 2008

Status: Completed 2011

Area: 6,800 m<sup>2</sup>

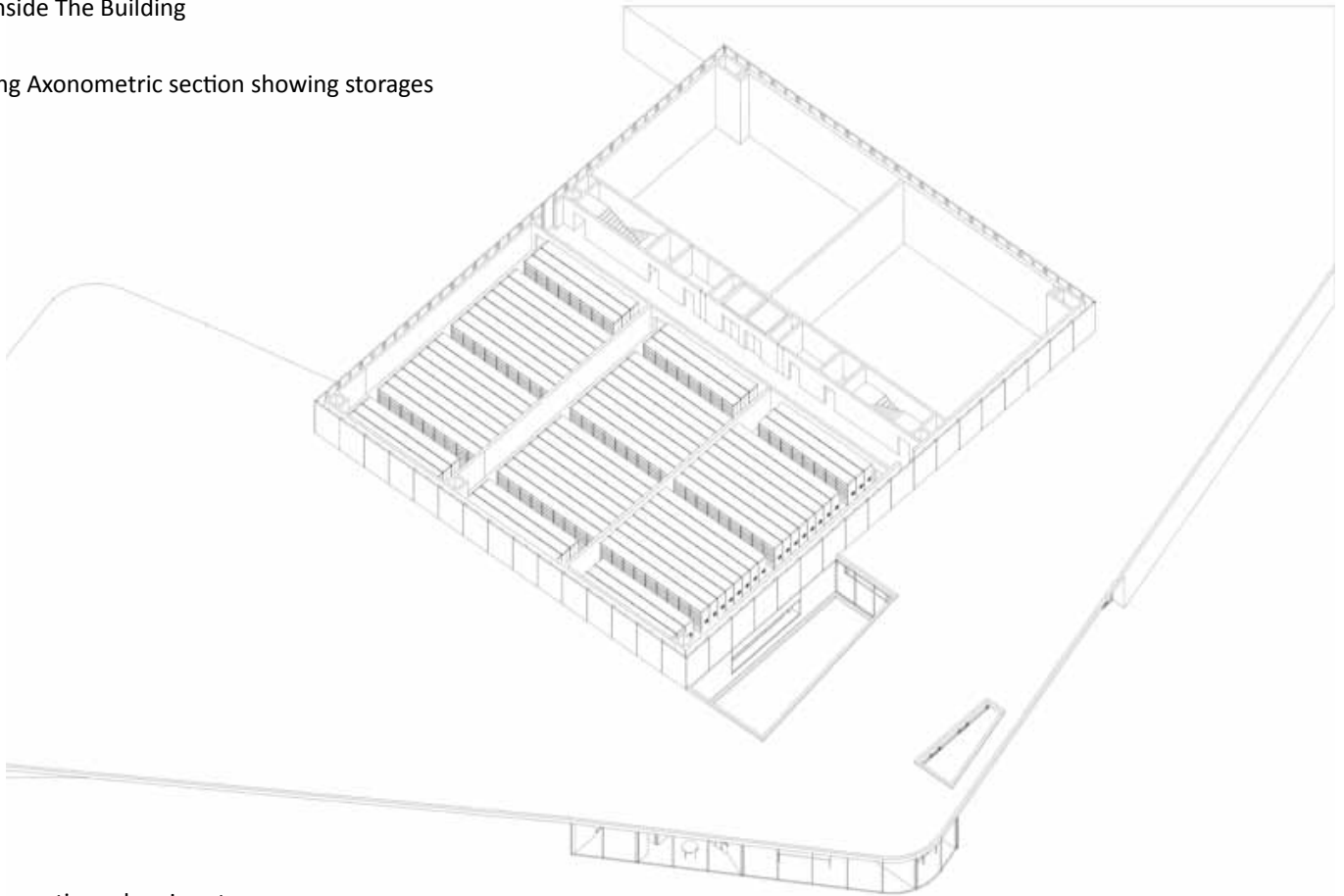
The reason why I got interested in the case is the storing strategies the architects chose – archives are composed by 20 similar store-houses on 5 floors; the design team worked on different floor heights to get the maximum out of the minimum amount of the built-up area. I would like to research how they hybridized storage spaces with offices, and study their plans and section drawings, as well as mechanical and fire protection systems.

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## Look Inside The Building

### Building Axonometric section showing storages



### Building sections showing storages





# INSTITUTE OF THE BOTANICAL GARDEN OF BARCELONA

## Short Description



## Project Data:

## Case Statement

## REFERENCES

\* Pictures and program diagrams go here



**SITE**

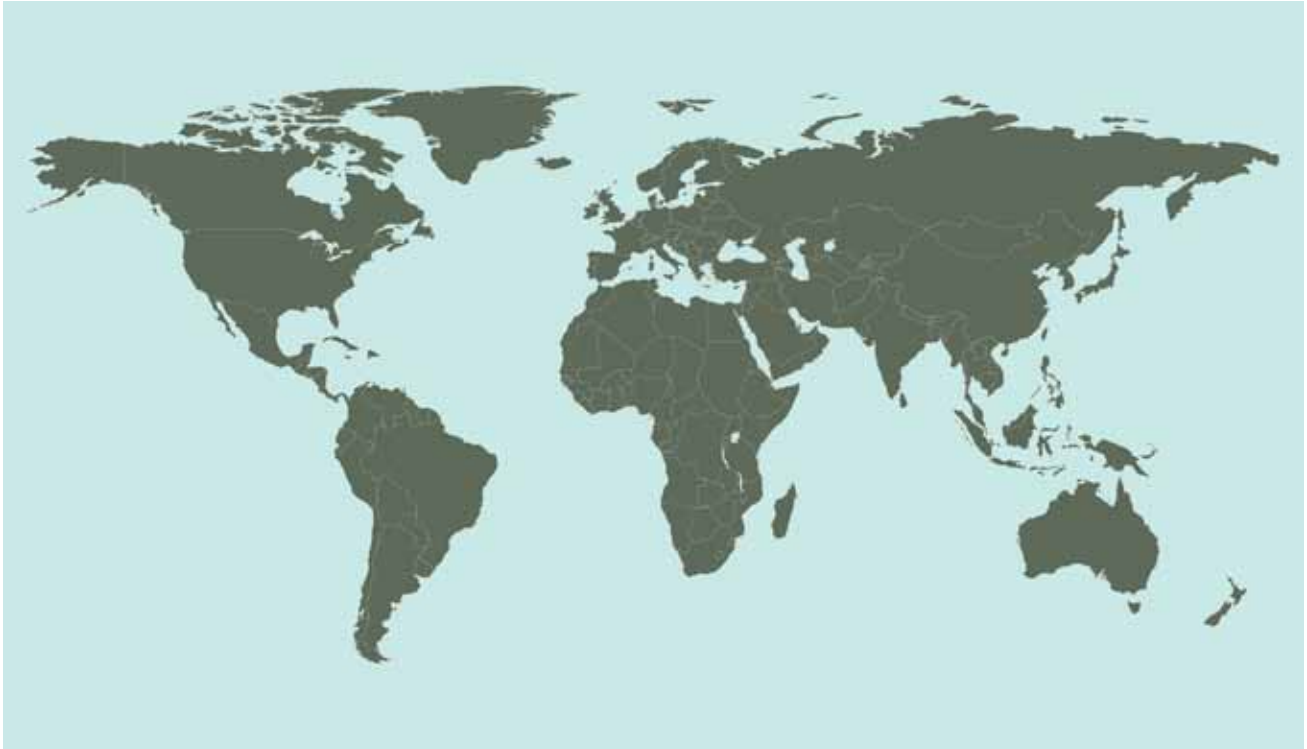


## SITE SELECTION CRITERIAS:

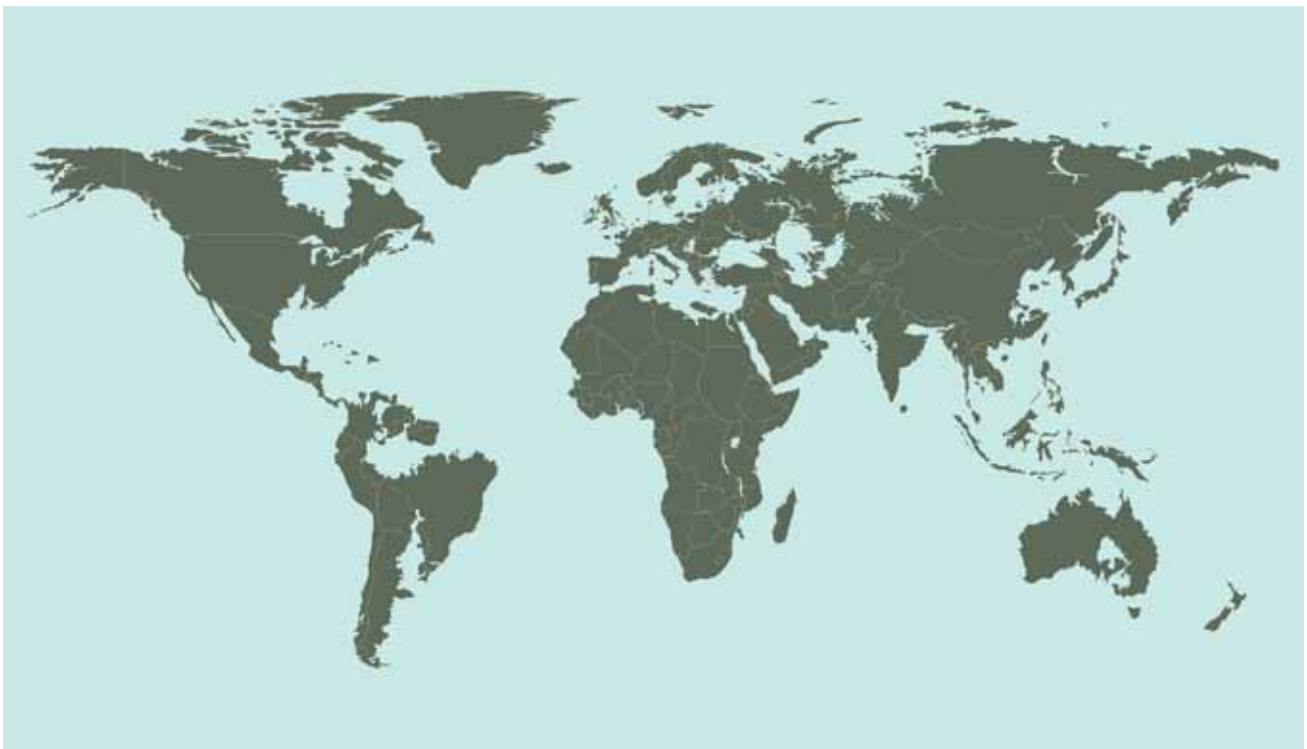
### 1 - Geographical Changes

As mentioned before, scientists predict the rise of water level by 7 to 23 inches (18 to 59 centimeters) in the entire world. Since the seed banks are crucial for survival, I need to make sure to pick up flood-safe locations.

World Map 2012



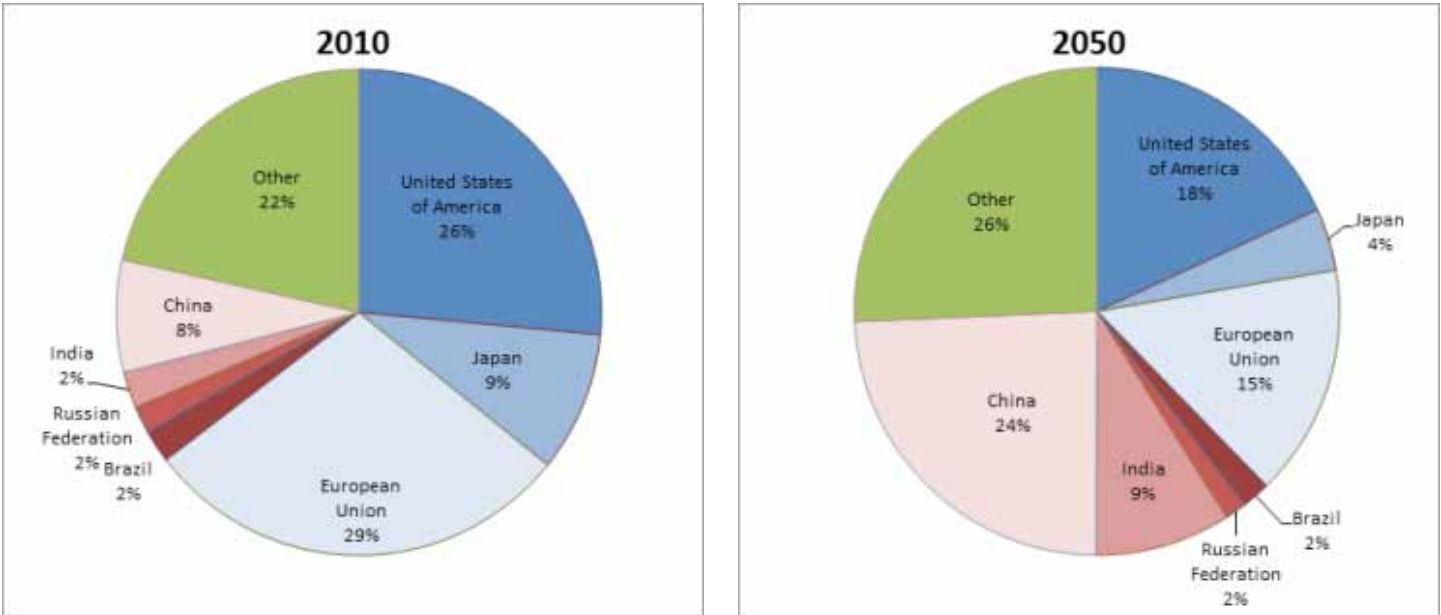
World Map 2050 - Flooding caused by the change of water level by 100 meters (328')



\*Source: Buffalo Web. < <http://vrstudio.buffalo.edu/~depape/warming/World100-8190.jpg>>

2 - Economic Consistency

According to the main-Board Trustee of Millenium Seed Bank Project Johnathan Drori, maintenance and research funds for Millennium Seed Bank is reaching ten million dollars annually. Maintaining the central buildings of the bank network will need a strong economical background and consistency, so the location is resulted by world GDP current projection and future predictions.



Regional shares of the world GDP in 2010 and 2050

\*Source: *Global Europe 2050. Executive Summary.* European Commission, European Research Area, Social Sciences and Humanities. Web. October 2011. <[http://ec.europa.eu/research/social-sciences/pdf/global-europe-2050-summary-report\\_en.pdf](http://ec.europa.eu/research/social-sciences/pdf/global-europe-2050-summary-report_en.pdf)>

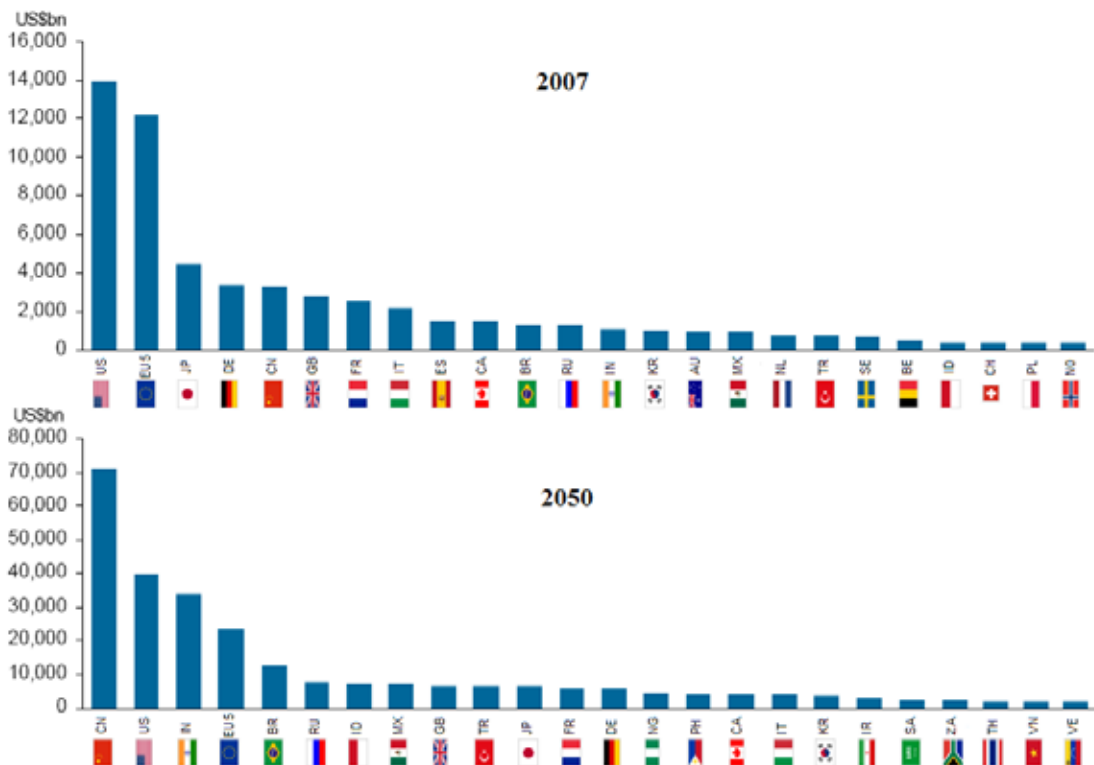


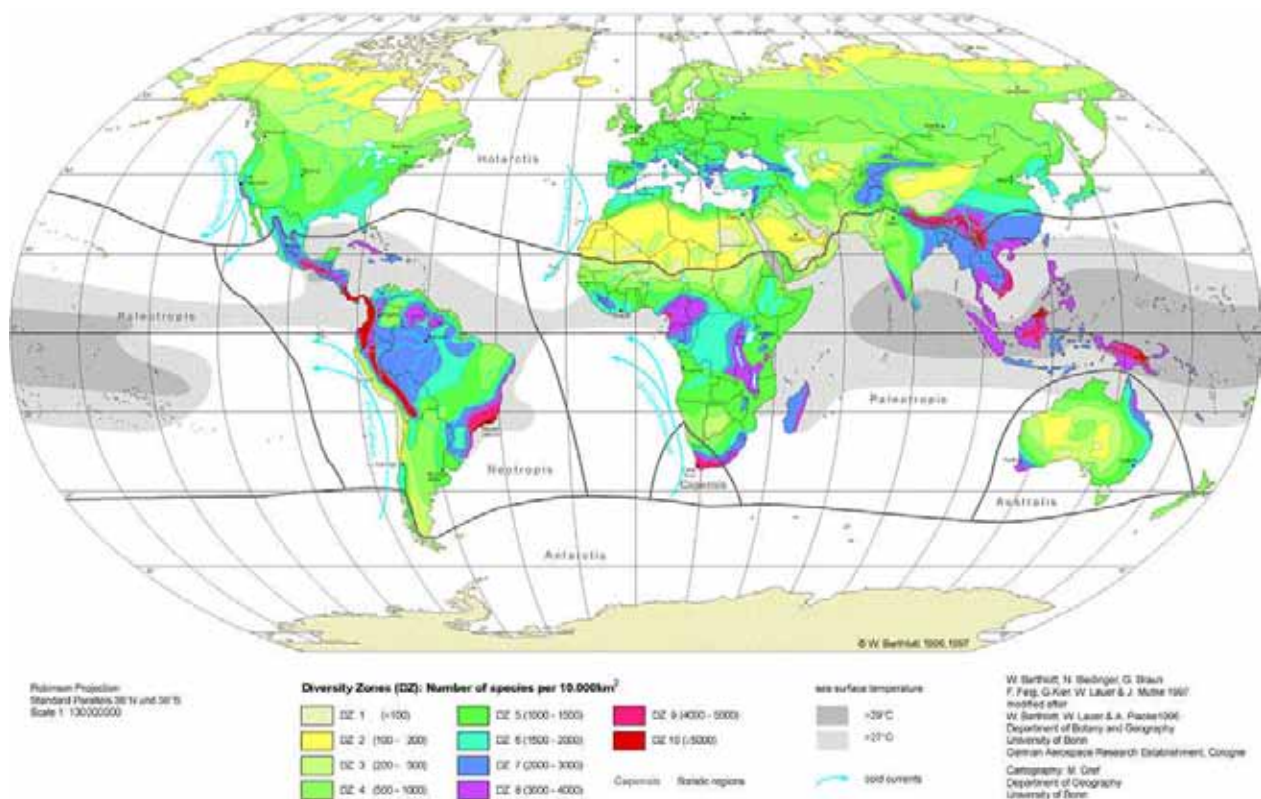
Chart showing world GDP in 2007 and prediction of GDP changes in 2050

\*Source: Global Sherpa. *BRIC Countries – Background, Latest News, Statistics and Original Articles.* Web. <<http://www.globalsherpa.org/bric-countries-brics>>



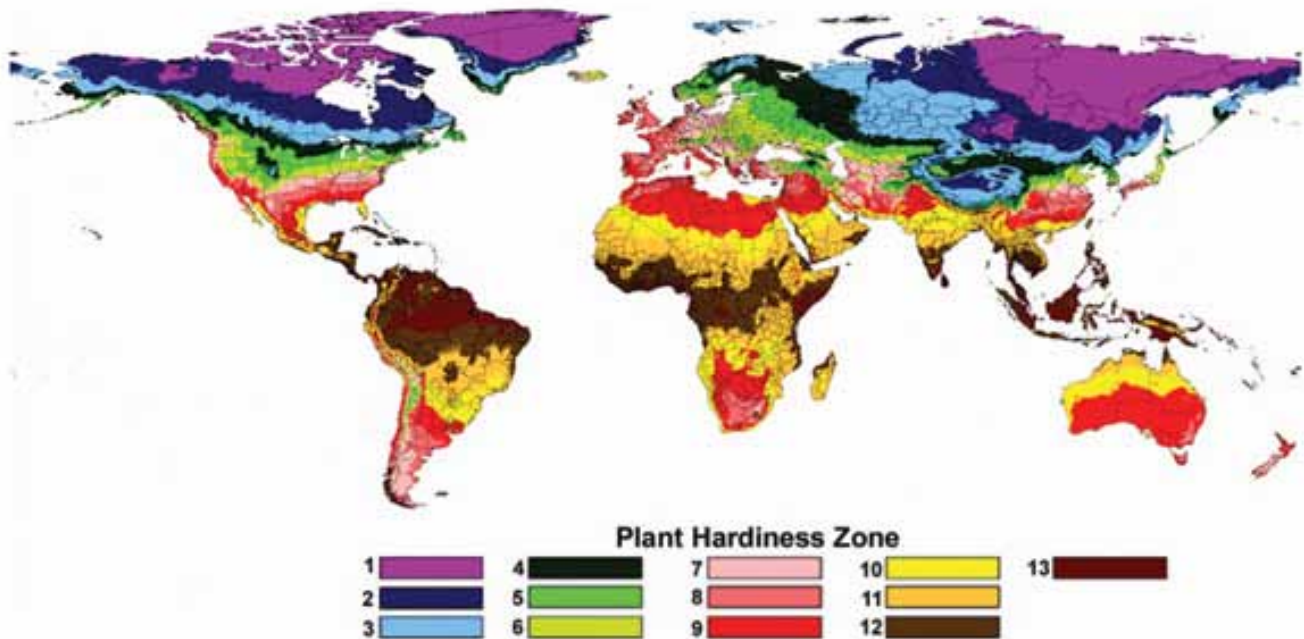
## 2 - Flora Diversity

While locating sub-centers, I need to find home for each type of plant, keeping in mind distances for transportation.



### GLOBAL DIVERSITY: SPECIES NUMBERS OF VASCULAR PLANTS

\*Source: Hamburg University. *Biodiversity – Number of Species and Individuals*. Web. August 2006 <<http://www.biologie.uni-hamburg.de/b-online/e56/56b.htm>>



### THIRTY-YEAR GLOBAL PLANT HARDINESS ZONE MAP FOR THE PERIOD 1978-2007

\*Source: Scientia Agricola. *Global plant hardiness zones for phytosanitary risk analysis*. (Piracicaba, Braz.) vol.65 no.spe Piracicaba. Dec. 2008. Web. <[http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S0103-90162008000700009](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0103-90162008000700009)>